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Title: Helping health workers understand unfolding outbreaks

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Helping health workers understand unfolding outbreaks

By Alina Deshpande

Imagine you're in the public health field, perhaps an epidemiologist, tasked with tracking diseases causing serious health problems in your area – especially new diseases that you have only seen reported in distant lands. If dengue, for example, suddenly sends scores of people to a hospital in the southern part of your state, local decisionmakers would turn to you to predict the steps needed to prevent an outbreak in your region.

With unlimited research time, subscriptions to specialty publications, and a deep awareness of the complex modeling tools on the market, you could probably create a report with some suggestions. Instead, what you need is a quick tool to help develop actionable information, and in the case of lethal infections, this tool could rapidly propose life-saving actions in the early days of the event.

This is the plan for a web-based disease-outbreak tool developed at Los Alamos National Laboratory, a quick-analysis resource called AIDO ("I-do") for Analytics for Investigation of Disease Outbreaks. Unlike traditional epidemiological models, this tool can be used by diverse group of users such as analysts, scientists, practitioners, decision makers, and the public at no cost. The website provides historic outbreak information for key outbreaks of nearly 40 different diseases, and it helps responders select the historic similarities to each new situation, even as an outbreak evolves over the first hours and days.

Why is that historic approach valuable? Given that history repeats itself, a review of comparable cases with similar climate, patient characteristics, treatment approaches, and the like could have great value in guiding a community's response.

Earlier is better in decision-making for public health responders, thus the sense of urgency in finding out what others have done. From vaccination to infant care to quarantines, those early policies and tactics are critical to handling what could be a mass-casualty event and steering it to a safer level.

The key is finding the epidemiological clues that will help decisionmakers make the right choices. Their choices could include a ring-vaccination approach, vaccinating and closely monitoring everyone who might have been in contact with sick patients. Or a full or partial quarantine of a home, village or entire town could be considered. But such decisions have wide

social impacts, and they need to be made from the most comprehensive data analysis, not on a hunch or a whim.

The scope of use for the AIDO tool is early while the situation is unfolding. In the first few days or weeks, clients use it over and over to update the site with day-to-day changes and see what insights are coming to light.

Professionals can already use the tool on the Los Alamos Biosurveillance Gateway website both to explore outbreak characteristics and to survey the training materials, such as the information pages where less-familiar diseases are described in greater detail. Being able to reference the "Dengue Facts" page, for example, allows the researcher to quickly access maps of the locations of the specific types of mosquitoes that transmit dengue to humans.

Given the breadth and depth of AIDO's outbreak library, a user might wonder if their own outbreak is anomalous compared to other historical outbreaks. The "Anomaly Detection' section is aimed at allowing the user to answer this question. Box plots and pie charts illustrate details of each outbreak's characteristics, helping users match patterns with their own situations. AIDO is not designed to call out a biothreat event, but could help flag an unusual circumstance, documenting outbreaks that represent the sometimes surprising diversity of disease presentation.

Q Fever, for example, is what's called a zoonotic disease, meaning that it travels from animals to humans. It normally occurs in farm areas, among agricultural workers who handle cattle or sheep that may be infected. But an unusual presentation of Q Fever happened in a Middle Eastern city, within a boarding school cafeteria—not the regular location for such a thing. It was only through careful epidemiological analysis that the path was identified, in this case an unusual but natural one, not a bioterror event: While the disease normally comes from contact with livestock, instead a community of feral cats had been taking turns sitting on an external air conditioner vent at the school, thus distributing the virus into the school cafeteria and across the full 300-plus students and staff. Nearly 200 of the schoolchildren were infected. For a healthcare researcher, this sort of situational report, found on AIDO, can be essential to understanding the unfolding outbreak.

So in theory, a quick website look-up could be not just a tool for finding better shopping options or hiring a plumber—the use of AIDO could make the different between a small-scale outbreak, and a full-on epidemic.

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Alina Deshpande is the group leader of the Biosecurity and Public Health group in Bioscience Division at Los Alamos National Laboratory, where she manages a group of nearly 60 staff members, technologists, post-doctoral fellows and students. Their work includes developing unique therapeutics, finding biomarkers for disease, using advanced genomics to identify and detect disease, developing health analytics and more.